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Title of the topic	:	**Seasonal variations and abundance of Diatoms in relation to Physicochemical parameters of Varor and Chikhla coasts, Dahanu, Maharashtra**
Name of the student	:	**Mr. Priyank Pankaj Gogari**
Basic Qualification	:	M.Sc. Botany
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Name of the Research Supervisor/Guide	:	**Dr. Onkar S Kotiwar**
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Name of the Research Centre	:	Gokhale education society's N.B.Mehta(V)Science college, Department of Botany Bordi -401701, District Palghar
Signature of the Student	:	
Signature of the Research Supervisor/Guide	:	

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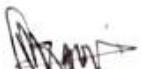

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Gokhale Education Society's
N. B. Mehta Science College
Bordi, Dahanu, Palghar
Pin - 401 701

Seasonal variation and abundance of Diatoms in relation to Physiochemical parameters of Varor and Chikhla costs, Dahanu, Maharashtra

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MR. PRIYANK PANKAJ GOGARI

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DR. ONKAR S KOTIWAR

ASSOCIATE PROFESSOR

GOKHALE EDUCATION SOCIETY'S

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Seasonal variation and abundance of Diatoms in relation to Physiochemical parameters of Varor and Chikhla coasts, Dahanu, Maharashtra

Introduction

Diatoms are microscopic unicellular or colonial (in the shape of filaments or ribbons, or tube dwelling) eukaryotic algae. Their cell walls are with silica shells, and they are ubiquitously distributed in aqueous habitats. Their name is derived from the Greek words (dia) ="through"+ (temnein) = "to cut, since their cells are divided in two halves or two box-like parts (frustules or valves). They are one of the most common types of phytoplankton. One can detect them in marine as well as in fresh water habitats, at high and low temperatures, at different pH values, in hypersaline environments, and in brackish water. The study of diatoms began in the 18th century. The name of the class Bacillariophyceae was derived from the genus Bacillaria Gmelin 1791, whereas "Diatom" refers to the genus Diatoma De Candolle 1805. Simonsen (1979) introduced a diatom system based on results from light and electron microscopy and constructed a key to the diatom families. Water is an important resource for all the living organisms. It is the most important parameter in shaping the land and regulating the climate. Over 97% of the Water on or near earth's surface is contained in the ocean, less than 3% is held is in land ice, ground water and all the fresh water lakes and rivers (Garrison, 1999). Diatoms especially play an important role in the oceans where they fix large amounts of carbon dioxide and synthesize carbohydrates that serve as a chief source of zooplankton food in the marine food chain. Diatoms, a unique group of algae colonising a wide range of aquatic habitats and contributing to human well-being in many ways. They play a key role in nutrient cycling and habitat provisioning and serve as food for many organisms. The most relevant supporting services are photosynthesis and primary production, as well as sediment formation. Regulating services as oxygen production, climate control or sediment stabilisations are difficult to discuss without diatoms. Many provisioning services, directly used by humans, can be obtained from diatoms. These are tangible products such as medicines and immunostimulants but direct technologies such as wastewater treatment, micro and nanotechnologies were also developed using diatoms. Finally, the impressive morphology and ornaments of diatom frustules make them one of the most spectacular microorganisms, inspiring artists or providing a number of educational opportunities. Thus, protecting aquatic habitats they inhabit is not simply a nature conservation issue but the key for human well-being in the future. Studying of the past, present, and future linked to diatoms as a tool for palaeolimnology, ecological status assessment of waters and climate modelling is essential. Diatoms are frequently the dominant microscopic photosynthetic microorganisms in natural waters, because most of their nutrition is derived from dissolved nutrients and reduced carbon, they be used as indicator of prevailing environment conditions, although diatoms reflect the chemical characteristics of the water, there are many other physical factors such as current speed, temperature and season that affect abundance and species diversity. (Cooler and Rockwood, 1989).

Rapid urbanization and economic development have resulted in unfavorable changes in the hydrology and ecology of marine water ecosystems, which are felt most acutely in the developing world. Natural changes in environmental conditions such as flow rate, water temperature, dissolved oxygen, alkalinity, acidity and food resource exert direct control on the population dynamics of marine water organisms, which give rise to characteristic biological communities within different ecosystems. Diatoms construct new walls only during cell division. After the cell divides, the epitheca and hypotheca separate, and new valves are laid down between them. Because the frustule cannot grow once it has been laid down, the mean size of a dividing population of diatoms gets smaller and smaller with time. This would be a rather bad state of affairs if diatoms could only reproduce by division! Fortunately, diatoms can also reproduce sexually, producing offsprings that secrete a wholly new cell wall from scratch.

Palghar is the newly form district formed on 2nd August 2014. It includes Palghar, Dahanu, Vasai, Vikramgad, Talasari, Mokhada, Wada and Jawhar talukas. Dahanu is located at 19.97°N 72.73°E.[3] It has an average elevation of 9.89 metres; to the west of the town is the coast of the Arabian

Sea while the east is lined with the Sahyadri ranges. Wadhwan Port - also known as Vadhavan Port - is a proposed new port 140km north of Mumbai on the coast of Maharashtra state, India. The port is to be built on 5000 acres of land reclaimed from the sea near the town of Dahanu, Palghar district. In 2017, the Dahanu Taluka Environment Protection Authority (DTEPA) blocked work on the Wadhwan port due to expected pollution and environmental destruction the port would bring. In June 2021, India's National Green Tribunal ordered a work stoppage at the port site until the Central Board Pollution Control Board formed a special panel and submitted a report on the environmental impact of the port. The port is facing strong resistance from the local people as well, siting environmental damage.

The basic requirements for diatom analysis have changed little over the last few decades in terms of sampling, slide preparation, microscopy and taxonomy but, on the other hand, there have been major improvements in our knowledge of diatom distribution and ecology and a revolution in our ability to analyse diatom data. These changes have been driven by the increasing recognition of the practical uses of diatoms as indicators of environmental change and by the development of novel numerical and computing techniques that allow diatom-environment relationships to be quantified. Despite these recent publications, teaching experience tells us that there is still a need to fill in respect to the global aspect of the identification of marine planktonic diatoms at the specific level.

The literature survey reveals that there are no investigation reports available about diatoms and quality of the marine water for the site selected for study in the Dahanu taluka. In the absence of any research work on the marine water diatoms in Dahanu, it is hard to scientifically arrive at any conclusion about their current status. Through this research, a preliminary attempt will be made to throw light on the seasonal study of diatoms and environmental health of both the coast of Dahanu taluka i.e Chikhla and Varor coast.

Study Rational

- Mhatre et al., (2022) studied Seasonal variations in phytoplankton species and abundance along the coast of Maharashtra from two different locations (Mumbai and Ratnagiri) A total of 84 species of phytoplankton were recorded from the region out of which 67 were diatoms.

- Distribution and diversity of phytoplankton in Kadalundi estuary, southwest coast of India was studied by Varghese, et al., (2022). A total of 87 species of phytoplankton belonging to 60 genera, 46 Families, 33 Orders, 8 Classes and 5 Phyla were recorded.

- Sabnam Banoo, et al., in 2022 studied Phytoplankton Population Dynamics in Relation to Environmental Variables at Paradip Port, East Coast of India. Around 41 species of phytoplankton were reported, the highest phytoplankton population was observed in the winter season, followed by the monsoon, pre-monsoon, and post-monsoon

- S. Krishna, et al., in 2022 studied the thane creek and found phytoplankton species.

- Aishee Bhowal, et al., in 2022 found that the a raphide diatom P. hustedtiana extends its biogeographic distribution to the Bay of Bengal (BoB), from where it had not been recorded prior to this study.

- Seasonal changes in the marine benthic diatom populations of southeast coast in the Kattumavadi region of Tamilnadu, India was studied by N. Nagarajana and M. Senthil Kumar in 2022

- Gorde *et.al.*, presented a study on the assessment of water quality parameters. It was focused on the determination of physicochemical parameters such as temperature, pH, EC, hardness, alkalinity, DO, BOD, COD, chloride ions, phosphate and sulphur estimation (2013).

- To monitor the effects of different chemicals on biological community: analytical and bioanalytical chemistry of diatom 387(4); studied by Sabater S., Guasch H., Ricart M., Romani A., Vidal G., Klunder C., and Schmit-Jansen M., (2007).
- Phytoplankton community structure derived from HPLC analysis of pigments in the faroe Shetland channel during summer 1999: the distribution at taxonomic groups in relation to physical/chemical condition in the photic zone were studied by Riegman and Kraag(2001).
- Saroj Patel and Ragothaman (2000) have carried out the studies on the water quality of Dandi Sea coast with reference to phytoplankton.
- Ragothaman and Saroj Patel (2001) have carried out the studies on the physico-chemical parameters of Dandi and Onjal-Machhiwad coast.
- Carrick *et al.,* 1998; Pan *et al.,* 1996 and Winter and Duthie, studied the linked changes in algal assemblages, particularly diatoms, to changes in water chemistry such as pH, phosphorus and nitrogen (2000)
- Fluxes of diatoms in the Dona Paula Bay west coast of India were studied by Garg & Bhaskar (2000).
- Seasonal variations in the physico-chemical and biological characteristics of the eastern Arabian Sea were studied by pillai, Gopinathan and Nandkumar (2000).
- Seasonal distribution and behavior of nutrients with reference to tidal rhythms a mulki Estuary south coast of India was studied by Vijay Kumar et al., (2000).
- Tillmann et al., (2000) have studied the planktonic primary production in the German Wadden sea.
- The influence of climate on phytoplankton community biomass in san Francisco Bay Estuary was studied by Lehman (2000).
- Hambright & Tamar (2000) have studied phytoplankton species diversity control through competitive exclusion and physical disturbances.
- Seasonal and diurnal variation of hydrobiological characters of coastal waters of Chennai (Madras) was studied by Subramanian & Mahadevan, (1999).
- Seasonal succession and growth in the plankton communities of the Gulf of Riga in relation to long term nutrient dynamics were studied by Yurkovskis et al., (1999).
- Marine phytoplankton of the mangrove Delta region of west Bengal, India, were studied by Santra and Choudhury (1991).
- Poulin and Cardinal (1982) have studied the sea ice diatoms from Manitounuk sound, southeastern Hudson Bay-II.
- Qasim et al., (1978) studied by biological productivity of coastal waters of India from Dabhol to Tuticorin.
- Radhakrishna et al., (1978) have studied primary production in the Arabian Sea.
- Qasim (1978) has Studied by distribution of chlorophyll-a in the India Ocean.

- Hydrography of the Andaman Sea during late winter was studied by Ramesh Babu and Sastry (1976).
- Seasonal distribution of phytoplankton pigments in the estuarine system of Goa was studies by Bhargava and Dwived (1976)
- Variations in physical characteristics of the water of Zuari Estuary were studied by Thomas et al., (1975)
- Sen Gupat et al., (1975) have studied chemical ocenanography of the Arabian. Sen observed hydrochemical and hydrographical features of the Northern Basin.
- Rao (1974) have studied Distribution of dissolved organic phosphorous and nitrogen in the Bay of Bengal.
- Singbal studied the diurnal variation of some physic- chemical factors in the zuari Estuary of Goa.
- Bhargava (1973) studied the diurnal variation in phytoplankton pigments of Mandovi Estuary Goa

Summary of study Rational:

Many research workers have worked on the hydrobiological and planktonological aspect of the various coast of India. But the knowledge about hydrobiological aspect of the west coast, especially in South Gujarat-North Maharashtra coast in very little.

Thus, against this backdrop, a research Seasonal variation and abundance of Diatoms in relation to Physiochemical parameters of Varor and Chikhla coasts, Dahanu, Maharashtra will be undertaken to analyze the water quality parameters and diatom identification of both the coasts in Dahanu Taluka Taluka by using following materials and methods.

Aim and objective of the study:

- To collect water samples individually from Varor and Chikhla coasts, Dahanu, Maharashtra understudy fortnightly.
- To analyze the water samples of both the coasts physicochemically with respect to the parameters such as pH, temperature (atmospheric and water), alkalinity, dissolved oxygen, Cl^-, Ca^{2+}, Mg^{2+}, silicate, phosphate, nitrate, nitrite, ammonia and chlorophyll.
- To note down observations, calculate and tabulate the results.
- To identify diatoms up to species level with the help of photomicrograph with the help of standard monographs.
- To perform quantitative analysis of diatoms.
- To analyze quantity of diatoms and physicochemical parameters statistically.
- To represent the results graphically and to compare them.
- To derive conclusion of the study.

Proposed Plan of work

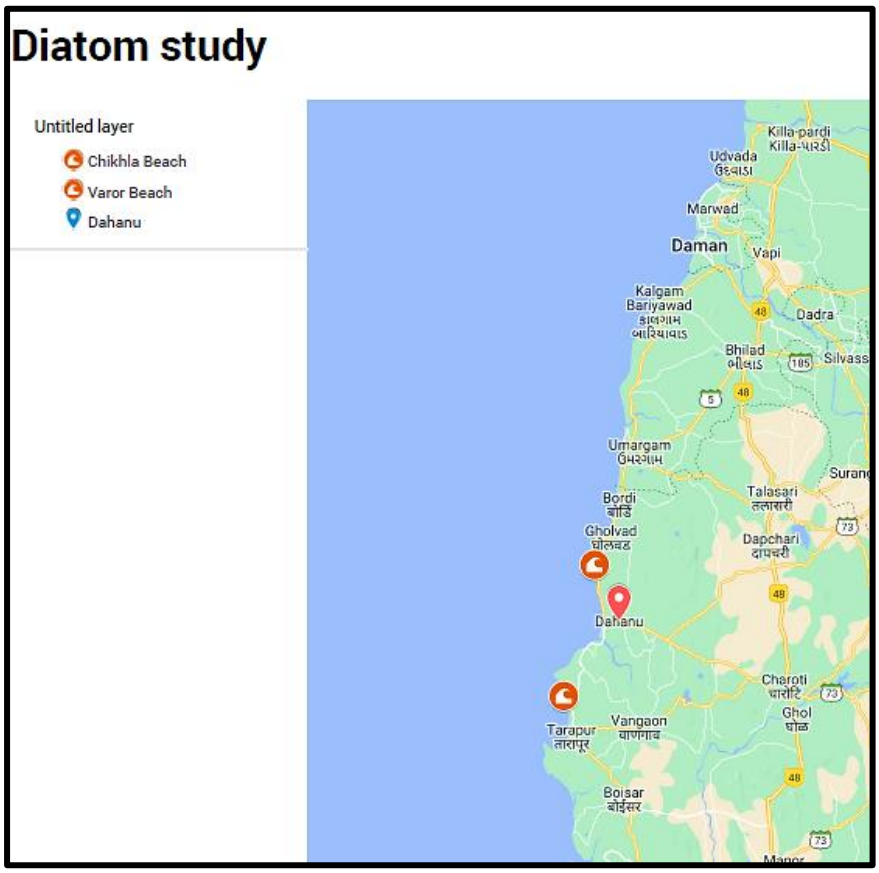
PHASE I	In this phase, The coast understudy will be visited and one site of each coast will be selected for water sample collection.
PHASE II	The marine water samples will be collected fortnightly from selected sites of both the coast. Temperature (atmospheric and water) will be measured at the time of collection. Collected sample will be taken to the laboratory for their analysis. 500 Liters of sea water will be drain through conical silk bolting net 20.From that 100ml of water with diatoms will be preserved.
PHASE III	Collected sea water samples will be evaluated physicochemical with respect to the parameters such as pH, temperature (atmospheric and water), alkalinity, dissolved oxygen, Cl^-, Ca^{2+}, Mg^{2+}, silicate, phosphate, nitrate, nitrite, ammonia, chlorophyll. And quantitative analysis of diatoms which is present in drained water will be done. Acid treatment will be given to preserved Diatom sample. Permanent slides will be prepared. Photomicrographs will be taken for identification of diatoms up to their species level.
PHASE IV	In this phase, Statistical analysis will be done between quantitative analysis of diatoms and qualitative analysis of physicochemical parameters.
PHASE V	In the last phase, the results obtained will be represented graphically and all the work, observations and inferences recorded will be presented in the thesis.

Material and method

1. SITE SELECTION

The coast sites, selected for the present study, are located in Palghar district's Dahanu Taluka and are approximately away from each other. Selected sites will be kept constant throughout the study. The coasts selected for study are as follows:

1. Chikhla, Taluka-Dahanu, District-Palghar.
2. Varor, Taluka-Dahanu, District-Palghar



2. WATER SAMPLE COLLECTION

Water samples will be collected separately every fortnight for 24 months before sunrise from both the coasts from the surface water, in clean plastic containers. Before collection, each container will be rinsed with the ethanol. Each sample water container will be capped tightly and carried to laboratory for further analysis.

Atmospheric and water temperature will be recorded by ordinary surface thermometer (centigrade), at the site itself.

3. PHYSICOCHEMICAL ANALYSIS OF WATER SAMPLES

The collected water samples will be analysed with respect to different physicochemical (Hydrological study) parameters as follows:

- pH will be measured by pH meter.
- The concentration of dissolved oxygen in the water samples will be determined by modified Winkler's method.
- Salinity will be estimated by Harvey's titration method using silver nitrate ($AgNO_3$).
- Calcium and magnesium will be determined by using the EDTA titrimetric method.
- Alkalinity will be determined by Titration (Theroux et al., 1943).
- Silicates will be estimated by colorimetric molybdosilicate method. It will be expressed as mg SiO_2 per liter.
- Phosphate-phosphorous will be estimated by colorimetric Stannous chloride method and will be expressed as microgram phosphate per liter.
- Nitrate-Nitrogen will be estimated by colorimetric Cadmium reduction method.
- Nitrite-Nitrogen will be estimated by Nesslerization method.
- Ammonia - Nitrogen estimation will be done Nesslerization method.

4. QUALITATIVE ANALYSIS OF PLANKTONS (BIOLOGICAL STUDY)

4.1. Optical density of Pigment extract

100 ml of sample will be centrifuged at 3000 rpm for 15 min to form the algal pellet. 10 ml of 90% acetone will be added, stirred well, transferred to clean test tube and will be kept in cold condition overnight. Optical density of pigment extract will be measured calorimetrically using wavelength of 400 to 500 nm.

5. QUANTITATIVE ANALYSIS (BIOLOGICAL STUDY) :

Diatoms will be collected by filtering 200 litres of water through conical bolting silk net of 20 mesh size. Known quantity of (20ml) of plankton sample will be taken and preserved with 4% iodine formalin solution. The settled plankton will be made to 10ml, from these 5 drops will be measured under the microscope. Five drops will be counted from preserved sample. The average value will be noted and will be multiplied by 20. One ml of water contains 20 drops. This result will show number of plankton/ml.

5.1. Acid treatment method for cleaning the diatoms:

From the preserved planktons sample, 20ml was taken in a beaker and 25 to 30ml concentrated H_2SO_4 was added. The material was kept for 2-3 days and sample was heated. While heating fumes appeared from the beaker that time a pinch of KNO_3 was added. The solution turned to colorless and after cooling distilled water was added and washed for 2 to 3 times with centrifuge machine. The centrifuge sample was preserved in 70% alcohol.

5.2. Preparation of permanent slide for diatoms:

From the preserved acid treated diatom material in the 70% alcohol, one drop will be taken and kept on cover glass, allowed to burn on the flame of spirit lamp for drying, and cooled. One drop of DPX will be added and mounted on the center of the slide and finally the slide will be kept in the incubator for removing air bubble and this will be the permanent slide for identification. Photo micrographs will be taken using appropriate tools. The specimen will be identified with the help of standard literature.(Hajos, Hendey, Subramanyam, Venkataraman)

5.3. Statistical Analysis:

Statistical analysis will be done between quantity of diatoms and physicochemical parameters. Photographs will be represented in plates and physicochemical parameters will be represented by tables and graphs.

Expected Outcomes of Study

- Results of qualitative analysis of water and its effect on quantity of diatoms will be noted.
- Species of diatoms will be enumerated.
  Quality and quantity of diatoms will vary seasonally.
- Pollution levels will be determined by hydro biological studies of diatoms.

Bibliography

- Bhargava R.M.S. and Dwided S.N., (1976): Seasonal distribution of phytoplankton Pigments in the Estuarince System of Goa, *Ind. J. Mar. Sci.,* **1**: 87-90.
- Cooler, R.A. and Rockwood J.P. (1989): Water pollution Biology. A Laboratory/Field Hand Book. Technomic publishing company Pensylvania, USA. Pp.38-40.
- Corner E.D.S. & Davies A.G. (1971): Advances in marine biology plankton as a Factor in the nitrogen and phosphorus cycles in the sea, Academic Press, New York, 9: 102-192.
- Cupp E.E., (1977): Marine Plankton Diatoms of The West Coast of North America, D-624 Koenigstein / West Germany.
- Desikachary T.V. (1986-89): Atlas of Diatoms, Madras Science Foundation Madras,ppl-809.
- Dhawan, R.M. (1970): Plankton and hydro biological factors of Kandla in the Gulf of Kutch during 1960-63.*Ind.Jour. Fisheries* **17:** 122:131.
- Fincham A.A. (1984): Basic marine biology, British museum (Natural History) Cambridge University Press, pp.20.
- Garg Anita and Bhasker P.V.(2000): Fluxes of diatoms in the Dona Paula Bay, West Coast of India. National Institute of Oceanography, Dona Paula, Goa. *Jour. Plank. Res.*,**22**: (11) 2125-2136.
- Garrison T. (1999): Oceanography an Invitation to marine science, 3rd edition, An International Thomson Publishing Company, London, New Yark, 1-22,307-344.
- Goldman J.c. (1976): phytoplankton response to waste water nutrient enrichment in continuous culture, *J. exp. Mar. Biol. Ecol.,***23:** 31-34.
- Gopinathan C.P., Rodrigo J.X., Kasim H.M. and Rajagopalan M.S.,(1994): phytoplankton pigments in relation to primary production and nutrients in the inshore waters of Tuticorin: South East Coast of India, *Ind. J. Mar. Sci.,* **23:** 209-212.
- Gouda R.(1996): Physico-chemical parameters in india Esturies. *Poll. Res.* 15(2): 212-128.
- Gouda R. and Panigrahy R.C.(1996): Ecology of phytoplankton in coastal waters off Gopalpur: East Coast of India, *Indian Jour. Mar. Sci.,* **25:** 81-84.
- Haranatha babu M.V. (1985) : studies on the Marine Algae of Devka Coast, M.Phil. Thesis, South Gujarat University, Surat.
- Hareesh Kumar P. V and Mathew Basil (1997): salinity distribution in the Arabian Sea , *Ind. Jour. Mar. Sci.,* **26**: 271-277.
- Jaiswal, R.N. (1990): Studies on the Hydrobiology of Tapti River from jalgaon Region (Maharashtra) with Reference to phytoplankton, M .Phil. Thesis, south Gujarat University, Surat.
- Manoj E. (1993): Studies on the Algal flora of polluted habitats of South Gujarat. Ph. D. Thesis., South Gujarat University Surat.

- Mc Connaughey B.H. (1970): Introduction to marine Biology, Toppan Company Ltd., Tokyo, Japan: 1-43.
- Newell G.E. and Newell R.C., (1963): Marine plankton a practical guide, Hutchinson Educational Ltd., London, 141-148.
- Patel S. M. and Ragothaman G. (2000): Studies on the water quality of Dandi sea Coast with reference to phytoplankton, *Int symp. on phycology*. University of Madras.
- Perkins E. J. (1976): physical and chemical features in estuarine waters: the biology of estuarine and waters, Academic press, New York, London:25-37.
- Pillai N.K., (1986): Introduction to Planktonology, Himalaya publishing House, Bombay.
- Pillai V. N. (1993): Variations in dissolved oxygen content of coastal waters along south west coast of India in space and tome, *Ind. J. Mar. Sci.* **22**: 279-282.
- Pillai V.N., (1991): Salinity and thermal characteristics of the coastal waters off South West Coast of India and their relation to major Pelagic Fisheries of the Region , *J. Mar. biol. Ass. India.*, **33**(1&2): 115-133.
- Qasim S.Z. and Sen Gupta R. (1981): Environmental characteristics of the Mandavi and Zauri estuarine system in Goa. Seminar on Estuaries, Dec. 7-11 NIO, Goa, India.
- Ragothaman G. and Harnatha babu M.V. (1987): Studies on the epiphytic diatoms of Devka coast, *Int .Symp. on phycology*, University of Madras, Jan: 8-13.
- Ragothaman G. and patel S. M.(2001):Studies on the water quality of Dandi and Onjal-Machhiwed from South Gujarat, National Conference on emerging areas in plant science, October 5-6. Palitana: 43.
- Ragothaman G. and Pratap A. P. K. (1981): Studies on the Hydrobiology of Dumas Coast, Seminar on estuaries, NIO, Goa, India: 7-11.
- Ragothaman G. and Ramachandra Reddy, (1982): hydrobiology of Tapti estuary, Surat., *Ind. Jour. Mar. Sci.* II: 256-258.
- Ragothaman G. and Ramaiah P. V. (1986): Physico-chemical parameters of tapti estuary. *Mar. Bio. & Mariculture,* Ed. V. Krishnamurthy: 1-14.
- Ragothaman G. and Rao B. (2001): Studies on the water quality of tapti estuary from south Gujarat coast, Nat. Cout. On Emerging areas in plant science, October 5-6, Palitama: 43.
- Santhanam R., Ramanathan N., Venkataramanujam K. and Jegatheesan G. (1987): phytoplankton of the Indian Seas an aspect of Marine Botany, Daya Publishing House, Delhi.
- Satpathy K.K., (1996): Seasonal Distribution of nutrients in the Coastal Waters of Kalpakkam East Coast of India, *Ind. J. Mar. Sci.* **25**: 221-224.
- Satyanarayan D., Sahu S. D. and Panigraphy P. K. (1994): Distribution of phytoplankton pigments and particulate organic carbon in the coastal waters of Visakhapatnam (Bay of Bangal), *Ind. J. Mar. Sci..*,**23**: 47-51.

- Sharma R.C.(1985): The Oceans Realities and prospects. Rajesh Publications, New Delhi, (India): 8-9.
- Subrahmanyan R. (1946): A Systematic account of the Marine Plankton Diatoms of the Madras coast, *proc. Indian Acad. Sci*., **24B**: 185-197.
- Subrahmanyan, R. and Sen Gupta R.(1965): Studies on the plankton of east Coast if India Part-II, *Proc. Indian Acad. Sci.,* **61B**: 12-24.
- Verlencar X. N. and Dhargalkar V.K, (1992): Primary productivity and nutrients in the Indian sector of the Southern Ocean, *Ind. J. Mar. Sci*., **21**: 6-12.
- Wetsteyn L.P.M.J. and Kromkamp J.C., (1994): Turbidity, nutrients and phytoplankton primary production in the Oosterschelde (The Netherlands) before during and after a large-scale coastal engineering project (1980-1990), *hydrobiology*, **282/283**: 61-78.
- Yurkovskis A, Kostrichkina E., Ikaunice A. (1999): Seasonal succession and growth in the plankton communities of the Gulf of Riga in relation to long-term nutrient dynamics, *Hydrobiologia*., **393**: 83-84.
- Varghese, Molly and Vinod, K and Gireesh, R and Anasu Koya, A and Ansar, C P and Nikhiljith, M and Sheeba, K B and Asokan, P K and Joshi, K K (2022) Distribution and diversity of phytoplankton in Kadalundi estuary, southwest coast of India. Journal of the Marine Biological Association of India, 64 (1). pp. 50-56. ISSN 2321-7898
- Banoo, S., Acharya, C., Behera, R.R. et al. Phytoplankton Population Dynamics in Relation to Environmental Variables at Paradip Port, East Coast of India. Thalassas (2022).
- Aishee Bhowal, Alfisa Siddique, Jasmine Purushothaman, Sanu V. Francis & Chelladurai Raghunathan (2022) First report of an epibiontic diatom Protoraphis hustedtiana R. Simonsen, 1970 (Protoraphidaceae) in association with copepod Pontella andersoni Sewell, 1912 from northern coastal waters of Bay of Bengal, Indian Ocean, Marine Biology Research, 18:3-4, 222-229, DOI: 10.1080/17451000.2022.2119250
- N. Nagarajana and M. Senthil Kumar (2022): Seasonal changes in the marine benthic diatom populations of southeast coast in the Kattumavadi region of Tamilnadu, India, AIP Conference Proceedings 2473, 020020 (2022); https://doi.org/10.1063/5.0096485